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SOLAR/1002-79/01

Monthly Performance Report

WASHINGTON NATURAL GAS
JANUARY 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

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MONTHLY PERFORMANCE REPORT

WASHINGTON NATURAL GAS COMPANY

JANUARY 1979

I. SYSTEM DESCRIPTION

The Washington Natural Gas Company site is a single-family residence in Kirkland, Washington. The home has approximately 2607 square feet of conditioned space. Solar energy is used for space heating the home and preheating domestic hot water (DHW). The solar energy system has an array of flat-plate collectors with a gross area of 591 square feet. The array faces south at an angle of 57 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage and to the space heating and hot water loads. Solar energy is stored underground in a 273-cubic-foot bin containing 27,300 pounds of smooth stones. The bin has two inches of styrofoam insulation. Preheated city water is stored in an 80-gallon preheat storage tank and supplied, on demand, to a conventional 50-gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, a gas furnace provides auxiliary energy for space heating. Similarly, a gas-fired unit in the DHW tank provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has four modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when there is no demand for space heating, and the temperature of the collector outlet exceeds that of the solar energy storage bin as measured by the control system sensors. Air circulates from the collector, through the air-to-liquid heat exchanger, through the air-handling unit and then through the solar energy storage bin to the collector. This mode exists as long as the temperature of the storage bin does not exceed 140°F.

Mode 2 - Storage-to-Space Heating: This mode activates when space heating is required, the solar insolation is insufficient to furnish the required energy from the collector, and the temperature of the solar energy storage bin is higher than 90°F, as indicated by the control system sensors. Air circulates from the solar energy storage bin, through the air-handling unit and gas furnace, then returns to the storage bin, bypassing the collectors.

Mode 3 - Collector-to-DHW Tank: This mode activates during the summer when the collector outlet temperature is higher than the temperature of the water in the preheat tank as indicated by the control system sensors. Air circulates from the collector, through the air-to-liquid heat exchanger and the air-handling unit, and returns to the collectors, bypassing the solar energy storage bin. Domestic water preheating also occurs in modes 1 and 4.

Mode 4 - Collector-to-Space Heating: This mode activates when the collector is operating, and the plenum temperature at the top of storage as indicated by the control system sensors is higher than the minimum value suitable for supplying heat to the house. Heated air is circulated through the house by the air-handling unit before being returned to the collector.

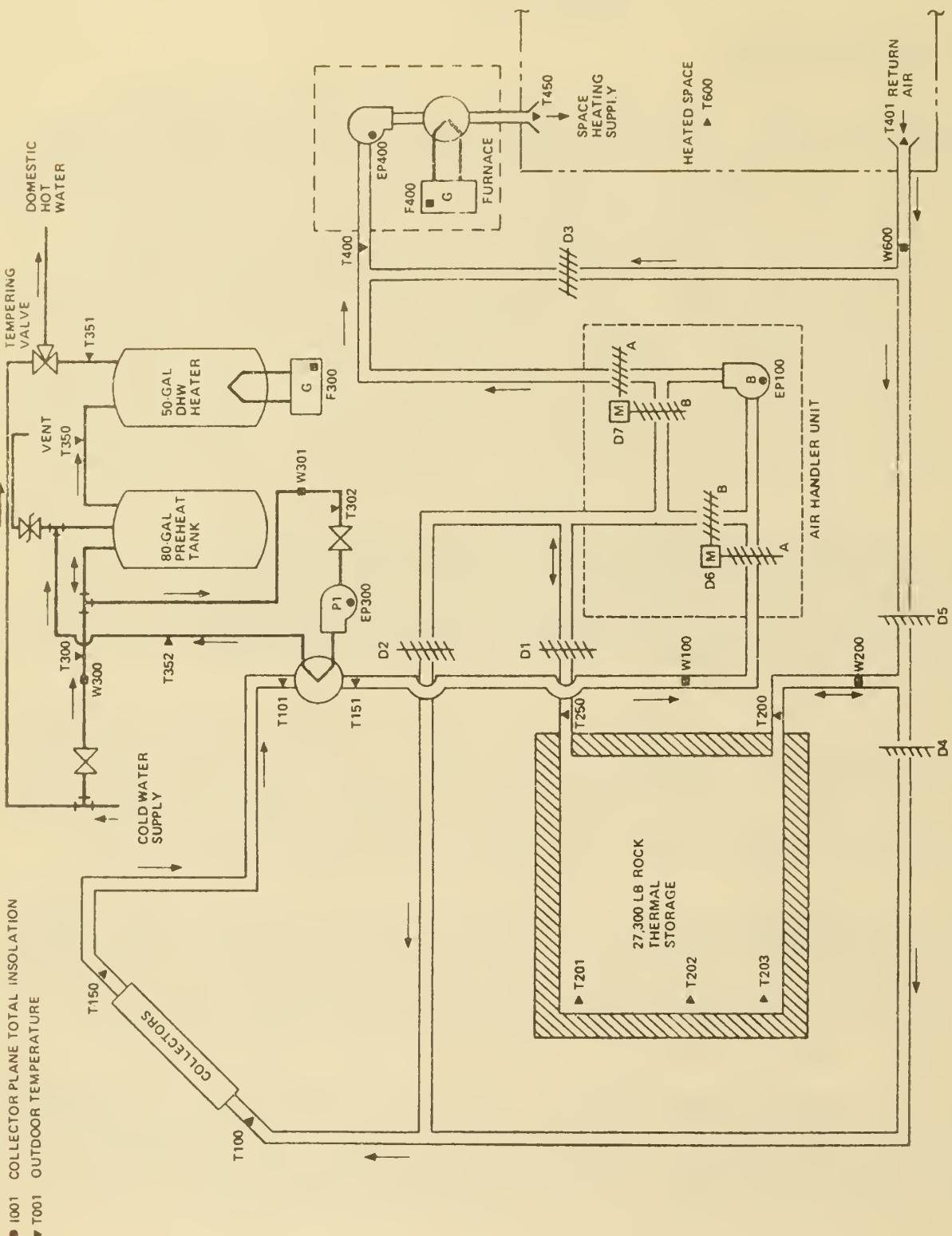


Figure 1. WASHINGTON NATURAL GAS SOLAR ENERGY SYSTEM SCHEMATIC

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was occupied and the solar energy system was operational for the entire month of January. Boeing was at the site between January 8 and January 11 conducting an air-mapping survey. The total collected solar energy was 3.6 million Btu with 0.37 million Btu consumed by the DHW subsystem and 0.78 million Btu consumed by the space heating subsystem. The amount of energy lost from storage was 1.3 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 10.8 million Btu for a daily average of 591 Btu per square foot. This was above the estimated average daily solar radiation for this geographical area during January of 465 Btu per square foot for a south-facing plane with a tilt of 57 degrees to the horizontal. The average ambient temperature during January was 36°F as compared with the long-term average for January of 38°F. The number of heating degree-days for the month (based on a 65°F reference) was 906, as compared with the long-term average of 831.

THERMAL PERFORMANCE

System - During January the solar energy system performed somewhat poorer than expected. The expected performance was determined from a modified f-chart analysis using measured weather and subsystem loads as inputs. Solar energy collected was 3.6 million Btu versus an estimated 1.3 million Btu. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 1.2 million Btu. System total solar fraction was 11 percent versus an estimated 25 percent.

Collector - The total incident solar radiation on the collector array for the month of January was 10.8 million Btu. During the period the collector loop was operating the total insolation amounted to 8.6 million Btu. The total collected solar energy for the month of January was 3.6 million Btu, resulting in a collector array efficiency of 33 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 2.2 million Btu. Operating energy required by the collector loop was 0.61 million Btu.

Storage - Solar energy delivered to storage was 2.2 million Btu. There were 0.73 million Btu delivered from storage to the space heating subsystem. Energy loss from storage was 1.3 million Btu. This loss represented 60 percent of the energy delivered to storage. The storage efficiency was 40 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 73°F.

DHW Load - The DHW subsystem consumed 0.37 million Btu of solar energy and 2.1 million Btu of auxiliary fossil fuel energy to satisfy a hot water load of 1.6 million Btu. The solar fraction of this load was 23 percent. Losses from the DHW subsystem were 0.84 million Btu. The DHW subsystem consumed a total of 0.02 million Btu of operational energy, resulting in an electrical energy expense of 0.02 million Btu. A daily average of 59 gallons of DHW was consumed at an average temperature of 150°F delivered from the tank.

Space Heating Load - The space heating subsystem consumed 0.78 million Btu of solar energy and 15.2 million Btu of auxiliary fossil fuel energy to satisfy a space heating load of 10.0 million Btu. The solar fraction of this load was 9 percent. Losses from the space heating subsystem were 6.0 million Btu. The space heating subsystem consumed a total of 0.52 million Btu of operational energy, resulting in fossil fuel energy savings of 1.5 million Btu.

OBSERVATIONS

Boeing has completed the air-mapping survey and has identified the relationships between the flow as measured by the sensors and the flow at various parts of the system as a function of mode. These relationships will be used in future analysis of this site.

There were days when the rock storage temperature was less than the return air temperature and caused auxiliary energy to be sent to storage. This system does not provide for a storage bypass when heating from the auxiliary source.

ENERGY SAVINGS

The solar energy system provided a total fossil fuel energy savings of 2.1 million Btu. The DHW subsystem provided a fossil fuel energy savings of 0.62 million Btu. The space heating subsystem contributed a fossil fuel energy savings of 1.5 million Btu.

III. ACTION STATUS

No action is planned at this time.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
 MONTHLY REPORT
 SITE SUMMARY

SITE: WASHINGTON NATURAL GAS
 REPORT PERIOD: JANUARY, 1979

SITE/SYSTEM DESCRIPTION:
 THE WASHINGTON NATURAL GAS SOLAR HEATING SYSTEM PROVIDES
 SPACE HEATING AND HOT WATER. AUXILIARY ENERGY IS SUPPLIED BY A
 FURNACE FOR SPACE HEATING AND BY A GAS WATER HEATER FOR HOT WATER.

GENERAL SITE DATA:
 INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE	50
AVERAGE BUILDING TEMPERATURE	65
EXCESS SOLAR CONVERSION EFFICIENCY	0.12
EXCESS OPERATING ENERGY	0.614
TOTAL SYSTEM OPERATING ENERGY	0.540
TOTAL ENERGY CONSUMED	20.908

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.637	10.017	0.609	11.523 MILLION BTU
SOLAR FRACTION	23	9		11 PERCENT
SOLAR ENERGY USED	0.374	0.778		1.247 MILLION BTU
OPERATING ENERGY	0.022	0.518		0.540 MILLION BTU
AUX. THERMAL ENERGY	1.263	9.145		10.276 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.		N.A. MILLION BTU
AUX. FOSSIL FUEL	2.104	15.242		17.126 MILLION BTU
ELECTRICAL SAVINGS	-0.022	0.000		-0.636 MILLION BTU
FOSSIL SAVINGS	0.623	1.454		2.078 MILLION BTU

SYSTEM PERFORMANCE FACTOR:

* DENOTES UNAVAILABLE DATA

② DENOTES NULL DATA

N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
 OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
 SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
 MONTHLY REPORT
 SITE SUMMARY

SITE: WASHINGTON NATURAL GAS
 REPORT PERIOD: JANUARY, 1979

SOLAR/1002-79/01

SITE/SYSTEM DESCRIPTION:
 THE WASHINGTON NATURAL GAS SOLAR HEATING SYSTEM PROVIDES
 SPACE HEATING AND HOT WATER. AUXILIARY ENERGY IS SUPPLIED BY A
 FURNACE FOR SPACE HEATING AND BY A GAS WATER HEATER FOR HOT WATER.

GENERAL SITE DATA:
 INCIDENT SOLAR ENERGY

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE
 AVERAGE BUILDING TEMPERATURE
 ECSS SOLAR CONVERSION EFFICIENCY
 ECSS OPERATING ENERGY
 TOTAL SYSTEM OPERATING ENERGY
 TOTAL ENERGY CONSUMED

11.430	GIGA JOULES
208175	KJ/SQ.M.
3.786	GIGA JOULES
68964	KJ/SQ.M.
2	DEGREES C
21	DEGREES C
0.12	
0.648	GIGA JOULES
0.570	GIGA JOULES
22.058	GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD	HOT WATER	HEATING
SOLAR FRACTION	1.727	10.568
SOLAR ENERGY USED	23	9
OPERATING ENERGY	0.394	0.821
AUX. THERMAL ENG	0.023	0.546
AUX. ELECTRIC FUEL	1.332	9.648
AUX. FOSSIL FUEL	N.A.	N.A.
ELECTRICAL SAVINGS	2.220	16.080
FOSSIL SAVINGS	-0.023	0.000
	0.657	1.534

SYSTEM PERFORMANCE FACTOR:

* DENOTES UNAVAILABLE DATA

@ DENOTES NULL DATA

N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
 OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
 SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECCSS)
MONTHLY REPORT

SITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY 1979

MONTHLY REPORT
IN AND STORAGE SUBSYSTEM (ECSS)

* DENOTES UNAVAILABLE DATA.
 @ DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCESITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

SOLAR/1002-79/01

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.070	0.000	**	28	**
2	0.098	0.000	**	31	**
3	0.132	0.000	0.184	38	0.227
4	0.811	0.649	0.257	37	0.309
5	0.830	0.781	0.253	40	0.311
6	0.815	0.784	0.177	42	0.306
7	0.576	0.525	0.202	42	0.318
8	0.635	0.592	0.25	39	0.223
9	0.113	0.083	0.025	*	0.000
10	0.002	0.005	0.000	40	-0.002
11	0.023	0.002	-0.000	42	0.000
12	0.007	0.000	0.000	43	0.384
13	0.681	0.627	0.261	39	0.000
14	0.023	0.000	0.000	39	0.000
15	0.109	0.000	0.000	37	0.000
16	0.068	0.004	0.002	40	0.034
17	0.769	0.716	0.294	44	0.383
18	0.723	0.663	0.257	39	0.355
19	0.005	0.000	0.000	42	0.000
20	0.071	0.000	0.000	50	0.000
21	0.303	0.195	0.079	40	0.261
22	0.240	0.066	0.030	39	0.126
23	0.185	0.071	0.028	41	0.150
24	0.297	0.180	0.077	40	0.260
25	0.246	0.157	0.064	38	0.260
26	0.029	0.000	0.000	35	0.000
27	0.102	0.007	0.003	38	0.031
28	0.406	0.295	0.125	33	0.308
29	0.787	0.735	0.307	36	0.390
30	0.866	0.780	0.327	36	0.378
31	0.811	0.712	0.289	34	0.356
SUM	10.834	8.628	3.589	-	-
Avg	0.349	0.278	0.116	39	0.331
NBSID	Q001	Q100	Q100	N100	N100

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCESITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

SOLAR / 1002-79/01

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F		STORAGE EFFICIENCY
				0.008	66	
1	*	*	*	0.005	66	*
2	*	*	*	0.040	68	*
3	0.093	0.014	0.064	75	68	0.579
4	0.179	0.050	0.034	81	64	0.641
5	0.177	0.065	-0.066	86	59	0.559
6	0.116	0.090	-0.047	84	21	0.213
7	0.154	0.048	-0.119	83	61	0.616
8	0.005	0.060	-0.008	76	12	0.300
9	-0.010	-0.021	-0.008	67	3	0.001
10	-0.000	-0.037	-0.011	68	00	1.000
11	0.000	-0.007	-0.013	67	00	1.000
12	0.161	0.012	0.0128	79	87	0.873
13	0.000	0.072	-0.132	74	00	1.000
14	0.000	0.016	-0.004	65	99	-39.722
15	0.001	-0.031	-0.006	65	79	0.792
16	0.177	-0.024	0.164	82	84	0.384
17	0.162	0.065	-0.003	93	00	1.000
18	0.000	0.078	-0.126	82	00	1.000
19	0.000	0.020	-0.037	68	00	1.000
20	0.050	0.019	-0.011	68	59	0.594
21	0.003	-0.003	-0.020	64	37	-7.037
22	0.007	-0.017	-0.000	64	41	-2.417
23	0.038	0.011	0.013	66	60	0.606
24	0.031	0.011	-0.012	66	03	-0.032
25	0.000	-0.030	-0.003	64	00	1.000
26	0.001	-0.027	0.002	65	92	-24.929
27	0.066	0.021	0.018	69	59	0.590
28	0.189	0.031	0.110	80	74	0.746
29	0.209	0.097	0.030	87	61	0.610
30	0.182	0.112	-0.011	88	55	0.556
31						
SUM	2.203	0.735	0.149	-	-	
AVG	0.071	0.024	0.005	73	401	0.401
NBS ID	Q200	Q201	Q202			N108

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEMSITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

SOLAR/1002-79/01

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU			SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
									HOT WAT. TEMP DEG F	WAT. TEMP DEG F	WAT. TEMP DEG F			
1	0.018	42	0.004	0.000	0.094	0.023	0.006	0.006	150	150	150	18	130	130
2	0.104	20	0.009	0.000	0.094	0.157	0.016	0.016	150	154	154	30	80	80
3	0.080	7	0.004	0.000	0.076	0.126	0.006	0.006	150	149	149	62	62	62
4	0.051	5	0.003	0.001	0.048	0.080	0.005	0.005	150	150	150	73	73	73
5	0.067	30	0.030	0.002	0.037	0.062	0.002	0.002	150	148	148	68	68	68
6	0.057	45	0.030	0.002	0.027	0.045	0.002	0.002	150	155	155	82	82	82
7	0.075	42	0.025	0.001	0.049	0.082	0.001	0.001	150	147	147	22	22	22
8	0.019	37	0.009	0.001	0.010	0.017	0.001	0.001	150	146	146	8	8	8
9	0.007	39	0.002	0.001	0.003	0.008	0.004	0.004	150	142	142	4	4	4
10	0.003	38	0.001	0.000	0.017	0.029	0.000	0.008	150	144	144	27	27	27
11	0.022	32	0.005	0.000	0.000	0.052	0.000	0.008	150	150	150	37	37	37
12	0.036	23	0.005	0.000	0.031	0.040	0.001	0.011	153	153	153	35	35	35
13	0.031	18	0.007	0.001	0.024	0.040	0.000	0.008	150	153	153	99	99	99
14	0.087	32	0.029	0.000	0.057	0.095	0.000	0.049	152	152	152	70	70	70
15	0.066	15	0.005	0.000	0.061	0.102	0.000	0.008	153	153	153	75	75	75
16	0.069	7	0.003	0.000	0.065	0.109	0.000	0.005	153	153	153	47	47	47
17	0.029	12	0.009	0.002	0.020	0.033	0.002	0.015	146	146	146	34	34	34
18	0.029	34	0.014	0.002	0.015	0.025	0.002	0.024	145	145	145	34	34	34
19	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	142	142	142	0	0	0
20	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	142	142	142	0	0	0
21	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	142	142	142	0	0	0
22	0.094	36	0.032	0.000	0.062	0.104	0.000	0.053	142	142	142	0	0	0
23	0.056	25	0.011	0.000	0.045	0.075	0.000	0.019	142	142	142	0	0	0
24	0.081	18	0.013	0.001	0.067	0.112	0.001	0.022	142	142	142	0	0	0
25	0.073	22	0.017	0.000	0.056	0.094	0.000	0.028	142	142	142	0	0	0
26	0.066	22	0.014	0.000	0.052	0.087	0.000	0.023	142	142	142	0	0	0
27	0.084	11	0.006	0.000	0.078	0.130	0.000	0.10	142	142	142	0	0	0
28	0.137	7	0.013	0.001	0.124	0.207	0.001	0.022	142	142	142	46	46	46
29	*	*	*	*	*	*	*	*	142	142	142	*	*	*
30	0.065	33	0.024	0.002	0.041	0.068	0.002	0.040	142	142	142	70	70	70
31	0.080	41	0.037	0.002	0.042	0.070	0.002	0.062	142	142	142	84	84	84
SUM	1.637	-	0.374	0.022	1.263	N.A.	2.104	-0.022	142	142	142	1837	1837	-
AVG	0.053	23	0.012	0.001	0.041	N.A.	0.068	-0.001	142	142	142	59	59	-
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	142	142	142	N307	N307	N308

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEMSITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU		AUX ELECT FUEL MILLION BTU		AUX FOSSIL FUEL MILLION BTU		ELECT ENERGY SAVINGS MILLION BTU		FOSSIL ENERGY SAVINGS MILLION BTU		BLDG TEMP DEG. F		AMB TEMP DEG. F	
					*	*	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	*	0.000	0.033	*	*	*	*	*	*	*	*	*	*	*	71	24
2	0.347	13	0.061	0.028	0.019	0.028	0.022	0.022	0.302	0.327	0.504	0.545	0.545	0.075	71	28		
3	0.388	16	0.077	0.013	0.017	0.017	0.013	0.013	0.265	0.284	0.442	0.473	0.473	0.102	72	31		
4	0.342	23	0.099	0.014	0.014	0.014	0.014	0.014	0.242	0.242	0.403	0.403	0.403	0.129	72	34		
5	0.382	26	0.053	0.012	0.026	0.026	0.026	0.026	0.331	0.331	0.552	0.552	0.552	0.165	71	36		
6	0.295	18	0.080	0.020	0.020	0.020	0.020	0.020	0.410	0.410	0.684	0.684	0.684	0.088	73	37		
7	0.411	19	0.080	0.030	0.030	0.030	0.030	0.030	0.385	0.385	0.642	0.642	0.642	0.050	71	38		
8	0.380	-8	-1	-0.039	-0.039	-0.039	-0.039	-0.039	0.335	0.335	0.559	0.559	0.559	-0.065	72	40		
9	0.347	-11	-2	-0.007	-0.007	-0.007	-0.007	-0.007	0.16	0.16	0.241	0.241	0.241	-0.012	72	41		
10	0.328	-12	-2	-0.018	-0.018	-0.018	-0.018	-0.018	0.08	0.08	0.145	0.145	0.145	0.030	71	40		
11	0.163	-11	-1	-0.018	-0.018	-0.018	-0.018	-0.018	0.016	0.016	0.573	0.573	0.573	0.119	71	37		
12	0.415	17	0.072	0.016	0.016	0.016	0.016	0.016	0.344	0.344	0.591	0.591	0.591	0.026	69	36		
13	0.339	-15	-5	-0.016	-0.016	-0.016	-0.016	-0.016	0.17	0.17	0.647	0.647	0.647	-0.052	71	38		
14	0.357	-9	-9	-0.031	-0.031	-0.031	-0.031	-0.031	0.19	0.19	0.408	0.408	0.408	-0.028	74	39		
15	0.229	-7	-7	-0.017	-0.017	-0.017	-0.017	-0.017	0.11	0.11	0.245	0.245	0.245	0.119	69	37		
16	0.203	35	0.072	0.072	0.072	0.072	0.072	0.072	0.131	0.131	0.219	0.219	0.219	0.129	67	42		
17	0.203	18	0.016	0.016	0.016	0.016	0.016	0.016	0.194	0.194	0.323	0.323	0.323	0.033	67	38		
18	0.203	19	0.019	0.019	0.019	0.019	0.019	0.019	0.176	0.176	0.294	0.294	0.294	0.051	67	40		
19	0.271	29	0.078	0.078	0.078	0.078	0.078	0.078	0.10	0.10	0.307	0.307	0.307	0.019	68	37		
20	0.196	10	0.020	0.020	0.020	0.020	0.020	0.020	0.19	0.19	0.526	0.526	0.526	-0.021	69	38		
21	0.203	9	0.019	0.019	0.019	0.019	0.019	0.019	0.10	0.10	0.392	0.392	0.392	0.018	69	37		
22	0.327	3	0.011	0.011	0.011	0.011	0.011	0.011	0.18	0.18	0.553	0.553	0.553	0.035	67	40		
23	0.319	-4	-0.013	-0.013	-0.013	-0.013	-0.013	-0.013	0.16	0.16	0.332	0.332	0.332	0.045	70	37		
24	0.245	4	0.011	0.011	0.011	0.011	0.011	0.011	0.235	0.235	0.472	0.472	0.472	0.035	70	32		
25	0.372	3	0.011	0.011	0.011	0.011	0.011	0.011	0.361	0.361	0.601	0.601	0.601	0.068	71	32		
26	0.381	-8	-0.030	-0.030	-0.030	-0.030	-0.030	-0.030	0.11	0.11	0.686	0.686	0.686	-0.050	69	34		
27	0.332	-8	-0.027	-0.027	-0.027	-0.027	-0.027	-0.027	0.17	0.17	0.598	0.598	0.598	-0.045	70	37		
28	0.304	7	0.021	0.021	0.021	0.021	0.021	0.021	0.15	0.15	0.283	0.283	0.283	0.162	71	32		
29	0.384	11	0.041	0.041	0.041	0.041	0.041	0.041	0.16	0.16	0.572	0.572	0.572	0.162	71	32		
30	0.388	25	0.097	0.097	0.097	0.097	0.097	0.097	0.12	0.12	0.484	0.484	0.484	0.187	71	30		
31	0.398	28	0.112	0.112	0.112	0.112	0.112	0.112	0.286	0.286	0.477	0.477	0.477	0.187	71	30		
SUM	10.017	-	0.778	0.518	9.145	N.A.	15.242	0.000	-	-	1.454	-	-	-	-	-		
AVG	0.323	9	0.025	0.017	0.295	N.A.	0.492	0.000	0.047	70	35	-	-	-	-	-		
NBS	Q402	N400	Q400	Q403	Q401	Q410	Q415	Q417	N406	N113	-	-	-	-	-	-		

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEMSITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

DAY OF MON. TH	SPACE COOLING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	OPER ENERGY USED MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY TEMP DEG F	AMB TEMP DEG F	
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31										
SUM	N.A.	—	N.A.	N.A.	N.A.	N.A.	N.A.	—	N.A.	—
AVG	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	—	N.A.	—
NBS	Q502	N500	Q500	Q503	Q501	Q508	Q512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

MONTHLY REPORT
ENVIRONMENTAL SUMMARYSITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

SD-AR/1002-79/01

DAY OF MONTH	TOTAL INSOLATION BTU/SQ. FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
						DEGREES	
1	118	N	24	28	28	N	NOT
2	166	O	28	31	*	A	P
3	224	A	31	33	38	P	P
4	1372	P	31	37	40	L	L
5	1404	P	34	36	42	I	C
6	1379	L	36	37	42	A	B
7	975	L	37	38	39	B	BLUE
8	1074	C	38	39	*		
9	1191	A	40	40	40		
10	39	B	41	42	42		
11	12	L	40	43	43		
12	1152	C	40	37	39		
13	1140	A	40	36	40		
14	184	B	41	38	44		
15	1115	L	41	39	39		
16	1301	C	42	42	42		
17	1224	A	42	37	39		
18	1224	B	42	37	39		
19	9	L	42	46	50		
20	120	C	42	46	40		
21	513	A	40	37	39		
22	405	B	40	38	41		
23	313	L	38	37	40		
24	502	C	38	34	38		
25	416	A	37	34	35		
26	449	B	37	37	38		
27	173	L	37	32	33		
28	687	C	37	32	36		
29	1332	A	37	32	36		
30	1466	B	37	32	36		
31	1373	L	30	34	34		
SUM	18332	N.A.	N.A.	-	-	-	-
Avg	591	N.A.	N.A.	36	39	N.A.	N.A.
NBS ID	Q001					N115	N114

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENTSITE: WASHINGTON NATURAL GAS
REPORT PERIOD: JANUARY, 1979

SOLAR/1002-79/01

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)											
					N	O	T	A	P	P	L	I	C	A	B	L
1	N	O	T	A	P	P	L	I	C	A	B	L	E			
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31																
SUM									*	*	*	*	*	*	*	
AVG									*	*	*	*	*	*	*	

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

NOTE:





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